

## PATENT ABSTRACTS OF JAPAN

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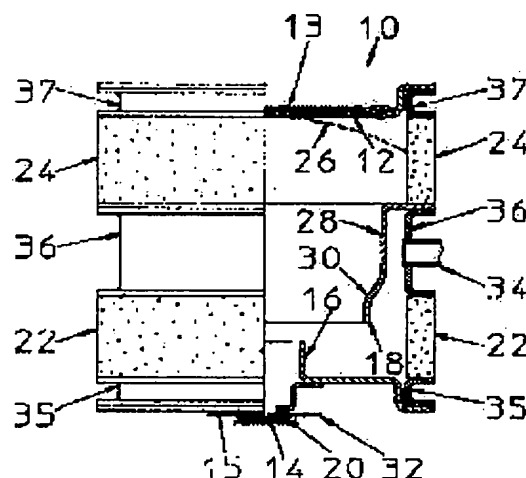
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## (54) PHOTOMULTIPLIER

(57)Abstract:

PURPOSE: To provide a photomultiplier with low transit time dispersion characteristics and low noise factor and capable of using in high speed operation system.

CONSTITUTION: A semiconductor photodiode 14 functions as an anode and accepts electrons from a photocathode 12. The focusing structure of a tube consist of two parts, one is an anode focusing electrode 16, locates near to the photodiode 14, and the other is a grid focusing electrode 18, locates in the middle of the photodiode 14 and the photocathode 12, has two different diameters, and operates at low voltage. These electrodes form a focusing electric field so that electrons are sent efficiently from the photocathode with large surface area to the photodiode with small surface area. The photodiode is designed and fixed so as to function as a terminal member given excellent timing characteristics.



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CLAIMS

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[Claim(s)]

[Claim 1] The envelope which was exhausted so that the vacua suitable for actuation of the electron tube might be formed in the interior and by which the hermetic seal was carried out, The aperture which constitutes a part of above-mentioned envelope which can pass a radiant ray, The phot cathode which will emit an electron if it is arranged at the inside of this aperture, the 1st electrical potential difference is supplied and the operation by the radiant ray which passes the above-mentioned aperture is received, If it is arranged in the above-mentioned envelope, the 2nd electrical potential difference is supplied and the electron from [ above-mentioned ] a phot cathode contacts, the electrical signal which changes according to the amount of the electron the semi-conductor photo diode generated on an output connection object, and within the above-mentioned envelope At least one anode plate focusing electrode and grid focusing electrode which have been arranged to the field between the above-mentioned phot cathode and semi-conductor photo diode, \*\*\*\* and arrangement of the direction of the above-mentioned anode plate focusing electrode is carried out rather than the above-mentioned grid focusing electrode soon at the above-mentioned semi-conductor photo diode. Each above-mentioned focusing electrode consists of conductive ingredients, the 3rd electrical potential difference is supplied to the above-mentioned grid focusing electrode, and the 4th electrical potential difference is supplied to the above-mentioned anode plate focusing electrode. By it The photomultiplier tube constituted so that the focusing electric field which make the above-mentioned semi-conductor photo diode point to the electron emitted from the above-mentioned phot cathode may be formed in the above-mentioned envelope.

[Claim 2] The above-mentioned phot cathode, the above-mentioned semi-conductor photo diode, and the photomultiplier tube according to claim 1 with which each above-mentioned focusing electrode is arranged in same axle.

[Claim 3] The photomultiplier tube according to claim 1 currently formed in the configuration which has the specific impedance characteristic which the above-mentioned output connection object of the above-mentioned semi-conductor photo diode adjusts in the impedance of the circuit of the exterior of the photomultiplier tube connected to this output connection object.

[Claim 4] The photomultiplier tube according to claim 1 with which the above-mentioned semi-conductor photo diode is located on the shaft of the photomultiplier tube.

[Claim 5] The photomultiplier tube according to claim 1 located in the crossover point of focusing electric field that the above-mentioned semi-conductor photo diode was formed of the electrical potential difference currently impressed to this photo diode, above-mentioned phot cathode, and each above-mentioned focusing electrode.

[Claim 6] The photomultiplier tube according to claim 1 with which the above-mentioned grid focusing electrode consists of two segments which have a mutually different diameter, and the direction of the diameter of the segment near the above-mentioned phot cathode is enlarged.

[Claim 7] The photomultiplier tube according to claim 1 both whose front faces of the above-mentioned aperture are parallel and flat fields mutually.

[Claim 8] The above-mentioned aperture is the photomultiplier tube according to claim 1 whose internal surface of the is a concave surface and whose outside surface is flat Men.

[Claim 9] Both the above-mentioned apertures are the photomultiplier tube according to claim 1 whose center of curvature is what has two curve front faces located in the interior of tubing.

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Application of the Invention] This invention relates to the photomultiplier tube containing the semi-conductor photo diode which works as an anode plate where it points to the electron emitted to the electric lamp and the discharge device from the phot cathode in more detail.

[0002]

[Background of the Invention] Although it is well-known to use combining a phot cathode and semi-conductor photo diode in the photomultiplier tube, generally such equipment is not used. The clear reason is because it is difficult to make the vacuum devices which have the photo diode of an area far smaller than the phot cathode and that of a large area. However, it is thought that it has an advantage, like a supplemental circuit configuration with few noises with sufficient gain stability excellent in the high, some the advantage of collection, for example, a rate, response time with small power consumption and gain linearity can be simplified in such equipment. Such an advantage should be acquired if equipment can be made appropriately.

[0003] If the semi-conductor photo diode which generates the electric-generating-power signal of the photomultiplier tube is used, since an electrical potential difference [ usual / to a semiconductor circuit or an integrated circuit ] within the limits will be obtained as an output signal electrical potential difference, the circuit connected to the latter part of the photomultiplier tube can use the advantage which such a technique has. Furthermore, the photomultiplier tube using a semi-conductor is especially useful when using it for a system which needs much tubing. Because, when it is going to use hundreds of [ dozens or ] tubing for one equipment, tubing using a semi-conductor has small power consumption, and it is because it becomes a big advantage for the configuration of attachment to be easy.

[0004] According to this invention, the structure where the optimal necessary property of the photomultiplier tube using a semi-conductor can be given is offered. According to this invention, photo diode with small surface area can be used with an aperture with a far bigger area than this, and a phot cathode, and the front face of another side can use [ one / a flat side and / front face ] the aperture a concave surface or both whose front faces are concave surfaces for both front faces by flat Men.

[0005] Moreover, according to this invention, compared with the conventional tubing, a transit-time dispersion (Transit Time Spread) property is acquired for the photomultiplier tube with a low noise figure far well. Furthermore, tubing which becomes possible [ using the output configuration which the transmission line can be made to adjust ], therefore uses for high-speed operation equipment, and functions good is obtained by having used the special chip attachment component.

[0006]

[Summary of the Invention] The various advantages mentioned above are acquired by using the focusing-electrode structure where both have only two focusing electrodes of comparatively easy structure. One electrode is an easy cylinder-like member which functioned as a target of the electron which functioned as a part of anode plate, namely, was emitted from the phot cathode, was made to approach a semiconductor chip, and has been arranged. The electrode of another side is the cylinder-like member which consists of two segments, and the direction of the segment of another side where some diameters of the segment were small and while it has been arranged at the semiconductor chip side has been arranged at the phot cathode side has a large diameter. This 2 segment form focused grid electrode is arranged to the middle field between a phot cathode and a semiconductor chip, and the comparatively low focusing electrical potential difference lower than 200 volts is impressed.

[0007] The semiconductor chip attachment component is arranged on the shaft of tubing. This

semiconductor chip attachment component is constituted so that it can connect all over the circuit where it operates as matched transmission line trailer material. Furthermore, in accordance with the shaft of tubing, a semiconductor chip sets spacing and is prepared so that it may be located in the focusing crossover field of an electron beam. Thus, by constituting, an electron is formed in a narrow beam and high collector efficiency is acquired so that all the electrons emitted from the phot cathode of a large area can act on the photo diode of small area comparatively.

[0008] The semi-conductor photomultiplier tube with the operating characteristic superior to the conventional semi-conductor photomultiplier tube can be obtained by making this easy structure from a suitable geometric dimension configuration, and arranging it in a vacuum envelope using a well-known photomultiplier-tube manufacturing technology.

[0009]

[Detailed Description of the Invention] Drawing shows the one half of the photomultiplier tube by the recommendation example of this invention in the cross section in alignment with that shaft. As for other one half, the external surface is shown. The photomultiplier tube 10 is substantially formed as coaxial structure. The phot cathode 12 inside the glass aperture 13 On the chip attachment component 15 by which the semi-conductor photo diode 14 has been arranged at the phot cathode 12 of tubing 10, and the reverse near edge It is arranged in the location of abbreviation middle where the anode plate focusing electrode 16 met and the grid focusing electrode 18 met the tube axis near the semi-conductor photo diode 14, respectively. Furthermore, the vacuum envelope of tubing 10 is formed of suitable ceramic insulation walls 20, 22, and 24 and flanges 35, 36, and 37.

[0010] In a recommendation example, although the semi-conductor photo diode 14 is silicon diode which operates in "electron-bombardment-induced-conductivity" mode, the silicon avalanche diode which operates in the same mode can also be used, and the semi-conductor photo diode of other formats can also be used in the configuration of the recommendation example of illustration. When the level of light is low, the direction of a silicon avalanche diode actually carries out better actuation.

[0011] Modification can be added to the example of illustration about an aperture 13. As a continuous line shows to drawing, an aperture 13 can also consist of two parallel flat Men, and as a dotted line 26 shows, it may use what made the internal surface the concave surface which has center of curvature in the photomultiplier tube 10. When the internal surface of an aperture 13 is made into the curved concave surface 26, the outside surface is good also as a concave surface also as flat Men. the case where an internal surface is made into a concave surface -- an outside surface -- which configuration -- be -- if it is the photo diode of the same small diameter, rather than what has both the 2nd flat page, good timing characteristics will be obtained and cathode collector efficiency will also become good further.

[0012] In the recommendation example of this invention, the bore of the envelope in which the die length of the-shaft orientations to photo diode 14 is formed from the phot cathode 12 of the coaxial photomultiplier tube 10 by about 58.42mm (about 2.3 inches) and insulating members 22 and 24 is about 63.5mm (about 2.5 inches). It does not pass over the effectual diameter of photo diode 14 to about 2.5mm, but, on the other hand, the diameter of the phot cathode 12 is about 50mm. Therefore, the ratio of the area of the phot cathode 12 and photo diode 14 is about 400 to 1. Big surface ratio can be attained very much by arranging photo diode 14 at the crossover point of the focusing electric field formed with these focusing electrodes 16 and 18 that are on a tube axis and have been arranged in same axle.

[0013] The location of the anode plate focusing electrode in a recommendation example is best to set in the relation between photo diode 14 and the medial axis of tubing 10. That is, it is because the coaxial cylinder-like front face of the anode plate focusing electrode 16 is on the radius of about 8.38mm (about 0.33 inches) from the core of photo diode 14 and the core of this photo diode 14 is on the shaft of tubing 10. Furthermore, the anode plate focusing electrode 16 is prolonged by about 10.16mm (about 0.4 inches) in shaft orientations along with tubing 10 toward the phot cathode from photo diode 14.

[0014] The location of the coaxial grid focusing electrode 18 in the photomultiplier tube 10 of a recommendation example can be more easily defined by relation with the phot cathode 12. With the dimension of the tubing 10 mentioned above, the edge by the side of the phot cathode 12 of the grid focusing electrode 18 is located from a phot cathode in the location of about 20.32mm (about 0.8 inches). The grid focusing electrode 18 consists of segments (part) 28 and 30. A bore is about 50.8mm (about 2 inches), the die length in alignment with a tube axis is about 18.58mm (about 0.73 inches), and, as for the segment 30 of the smaller one, the effective length of the segment 28 of the larger one to whom a bore is about 49.276mm (about 1.94 inches), and meets a tube axis is about 7.62mm (about 0.3 inches). If these dimensions are adopted as a photo-multiplier 10 and about 100 volts is added to it at an above-mentioned

grid construction, 100% of collector efficiency can be acquired substantially.

[0015] The advantage which should mention this invention especially is a point which can be made a configuration which adjusts the connection to the semi-conductor photo diode 14 in an external circuit. The chip attachment component 15 functions as an edge seal of tubing 10. A wire or a strip connection object is sufficient as the connection object 32 over the photo diode 14 attached on the chip attachment component 15. The dimension configuration of this basic structure cannot affect the build up time of an anode plate pulse, but it can define it so that a spurious ringing phenomenon moreover may not be produced, so that the impedance used as the termination which it adjusted to the consecutive circuit may be presented therefore.

[0016] He can fully understand the structural description of others of the photomultiplier tube 10 in the field of a photomultiplier-tube technique. It is attached in the external flange 36, and using this, during manufacture of tubing, the tubing configuration 34 for exhaust air can process a gas suitably, and can discharge it again. Moreover, in order to energize the phot cathode 12, from the bead heated electrically, a flange 36 may be penetrated and the electric feed through used for other purposes of \*\* which evaporate antimony may be attached. Flanges 35 and 36 function on the anode plate focusing electrode 16 and the grid focusing electrode 18 also as an electrical connection member for supplying a focusing electrical potential difference.

[0017] The fundamental structure of the seal between ceramic-metals is also fully understood by this technical field, therefore the detail of the assembly of the envelope of tubing 10 is not explained.

[0018] If the structure of this invention is used, the photomultiplier tube with the quick response time with very sufficient effectiveness which can use a very easy supplemental circuit will be obtained. Therefore, it also becomes possible to become possible to use much photomultiplier tubes with one equipment, and to use the photomultiplier tube for a high-speed operation circuit, without making the thermal emission from a photomultiplier-tube partial pressure circuit increase.

[0019] It cannot pass over the photomultiplier tube illustrated and explained in the recommendation example, but many alterations can give it to the function and configuration of a configuration component of tubing, and it can also be replaced with the thing of the example of illustration of an equivalent means. Furthermore, within the limits of this invention, a specific configuration can be separated from others and can also be used. For example, the envelope of tubing can consist of a ceramic or glass. Even if it uses which insulator, the technique of sealing to the metal of these insulators is established by this technical field.

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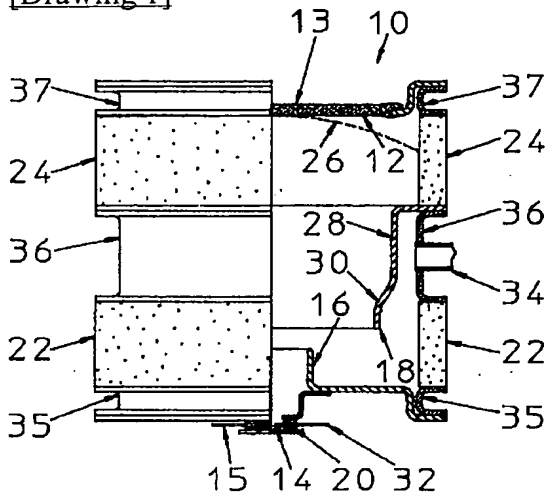
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DRAWINGS




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[Drawing 1]

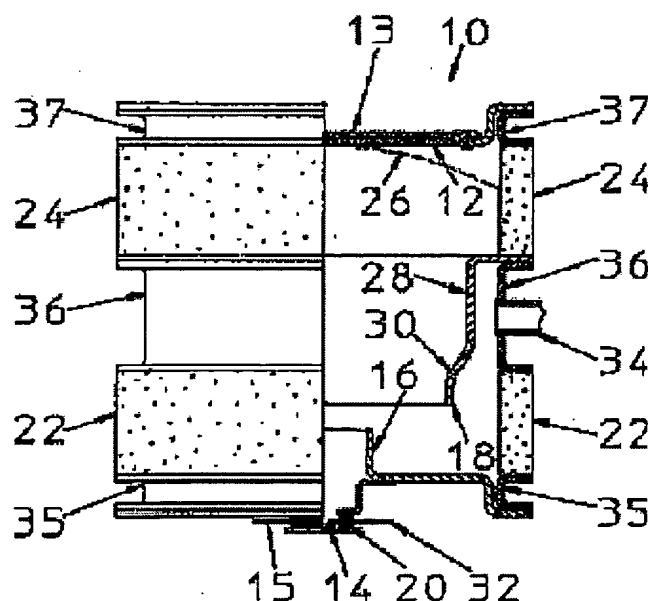


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**PHOTOMULTIPLIER TUBE****Patent number:** JP5054849**Publication date:** 1993-03-05**Inventor:** CHIYAARUZU EMU TOMASETSUTEI**Applicant:** BURLE TECHNOLOGIES**Classification:****- international:** H01J43/04; H01J43/12; H01J43/00; (IPC1-7):  
H01J43/06; H01J43/28**- european:** H01J43/04; H01J43/12**Application number:** JP19920026165 19920116**Priority number(s):** US19910643179 19910117**Also published as:** EP0495283 (A)  
 US5120949 (A)  
 EP0495283 (B)[Report a data error here](#)**Abstract of JP5054849**

**PURPOSE:** To provide a photomultiplier with low transit time dispersion characteristics and low noise factor and capable of using in high speed operation system. **CONSTITUTION:** A semiconductor photodiode 14 functions as an anode and accepts electrons from a photocathode 12. The focusing structure of a tube consist of two parts, one is an anode focusing electrode 16, locates near to the photodiode 14, and the other is a grid focusing electrode 18, locates in the middle of the photodiode 14 and the photocathode 12, has two different diameters, and operates at low voltage. These electrodes form a focusing electric field so that electrons are sent efficiently from the photocathode with large surface area to the photodiode with small surface area. The photodiode is designed and fixed so as to function as a terminal member given excellent timing characteristics.



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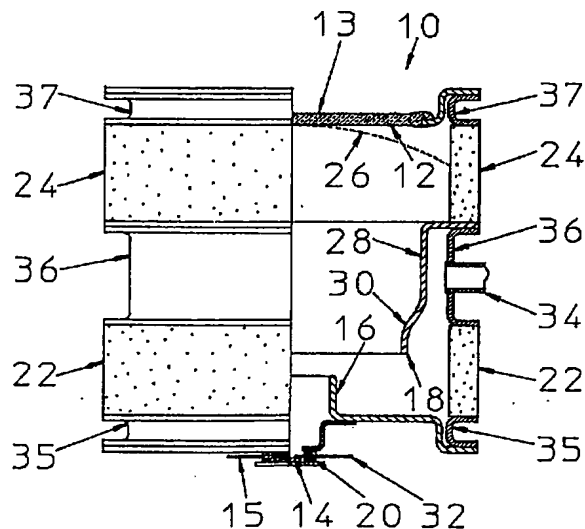
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(54)【発明の名称】 光電子増倍管

(57)【要約】

【構成】 光電子増倍管において、半導体ホットダイオード(14)が陽極として機能し、ホットカソード(12)からの電子を受け取る。管内の集束構造は2つの部分からなり、一方が陽極集束電極(16)でホットダイオードに近く、他方がグリッド集束電極(18)でホットダイオードとホットカソードのほぼ中間にあり、2つの異なる直径をもち、かつ、低い電圧で動作する。これらの電極は、大面積のホットカソードからの電子が小面積のホットダイオードへ高効率で送られるようにする集束電界を形成する。また、ホットダイオードの取り付けは、優れたタイミング特性を与える終端部材として機能するように設計される。

【効果】 良好な走行時間ばらつき特性と低雑音指数を有し、高速動作システムにも用いることのできる光電子増倍管が得られる。





## 【特許請求の範囲】

【請求項1】 電子管の動作に適した真空状態を内部に形成するように排気された気密封止された外囲器と、放射線が通過することができる、上記外囲器の一部を構成する窓と、

この窓の内面に配置され、第1の電圧が供給されており、上記窓を通過する放射線による作用を受けると電子を放出するホトカソードと、

上記外囲器内に配置され、第2の電圧が供給されており、上記ホトカソードからの電子が接触すると、その電子の量に応じて変化する電気信号を出力接続体に生成する半導体ホトダイオードと、

上記外囲器内で、上記ホトカソードと半導体ホトダイオードとの間の領域に配置された少なくとも1つの陽極集束電極とグリッド集束電極と、を有し、

上記グリッド集束電極よりも上記陽極集束電極の方が上記半導体ホトダイオードに近く配置されており、上記各集束電極は導電性材料で構成されていて、上記グリッド集束電極には第3の電圧が供給され、上記陽極集束電極には第4の電圧が供給されており、それによって、上記ホトカソードから放出された電子を上記半導体ホトダイオードに指向させる集束電界が上記外囲器内に形成されるように構成されている、光電子増倍管。

【請求項2】 上記ホトカソードと、上記半導体ホトダイオードと、上記各集束電極が同軸的に配置されている、請求項1に記載の光電子増倍管。

【請求項3】 上記半導体ホトダイオードの上記出力接続体が、この出力接続体に接続される光電子増倍管の外部の回路のインピーダンスに整合する特定のインピーダンス特性を有する構成に形成されている、請求項1に記載の光電子増倍管。

【請求項4】 上記半導体ホトダイオードが光電子増倍管の軸上に位置している、請求項1に記載の光電子増倍管。

【請求項5】 上記半導体ホトダイオードが、このホトダイオードと上記ホトカソードと上記各集束電極とに印加されている電圧によって形成された集束電界のクロスオーバー点に位置している、請求項1に記載の光電子増倍管。

【請求項6】 上記グリッド集束電極が互いに異なる直径を有する2つのセグメントで構成されており、上記ホトカソードに近いセグメントの直径の方が大きくされている、請求項1に記載の光電子増倍管。

【請求項7】 上記窓の両表面が互いに平行で平坦な面である、請求項1に記載の光電子増倍管。

【請求項8】 上記窓はその内表面が凹面であり、外表面が平坦面である、請求項1に記載の光電子増倍管。

【請求項9】 上記窓は曲率中心が共に管の内部に位置する2つの湾曲表面を有するものである、請求項1に記載の光電子増倍管。

## 【発明の詳細な説明】

【0001】

【発明の利用分野】この発明は電気ランプ及び放電装置に、さらに詳しくは、ホトカソードから放出された電子が指向される陽極として働く半導体ホトダイオードを含んでいる光電子増倍管に関するものである。

【0002】

【発明の背景】光電子増倍管においてホトカソードと半導体ホトダイオードを組み合わせて用いることは公知であるが、そのような装置は一般的には使用されていない。その明らかな理由は、大面積のホトカソードとそれよりもはるかに小さな面積のホトダイオードを有する真空装置を作ることが難しいためである。しかし、このような装置には、幾つかの利点、例えば、収集率が高い、応答時間が優れている、電力消費が小さい、利得安定性及び利得直線性が良い、雑音が少ない、補助回路構成を簡単に出来る等の利点を持っていると考えられる。装置を適切に作ることができれば、このような利点が得られる筈である。

【0003】光電子増倍管の電気出力信号を発生する半導体ホトダイオードを用いると、出力信号電圧として、半導体回路あるいは集積回路に対する通常の範囲内の電圧が得られるので、光電子増倍管の後段に接続される回路は、このような技術の持つ利点を利用することが出来る。さらに、半導体を用いた光電子増倍管は、多数の管を必要とするようなシステムに使用する時、特に有用である。なぜなら、1つの装置に数十あるいは数百の管を用いようとする場合、半導体を用いた管は消費電力が小さく、付属装置の構成が簡単であるということは大きな利点となるためである。

【0004】この発明によれば、半導体を用いた光電子増倍管の最適所要特性を与えるような構造が提供される。この発明によれば、表面積の小さなホトダイオードをこれよりもはるかに大きな面積を持つ窓及びホトカソードと共に用いることができ、また、両方の表面共平坦面、一方の表面が平坦面で他方の表面が凹面、または両方の表面共凹面である窓を用いることができる。

【0005】また、この発明によれば、従来の管に比べて走行時間ばらつき(Transit Time Spread)特性はるかに良く、また、雑音指数が低い光電子増倍管が得られる。さらに、特別なチップ保持部材を用いたことにより、伝送線に整合させることのできる出力構成を用いることが可能となり、従って、高速動作装置に用いて良好に機能する管が得られる。

【0006】

【発明の概要】上述した種々の利点は、両方とも比較的簡単な構造の集束電極を2つだけ有する集束電極構造を用いることにより得られる。一方の電極は陽極の一部として機能し、即ち、ホトカソードから放出された電子のターゲットとして機能し、半導体チップに近接させて配

置された簡単なシリンダ状部材である。他方の電極は2つのセグメントからなるシリンダ状部材で、半導体チップ側に配置された一方のセグメントは直径が幾らか小さく、ホトカソード側に配置された他方のセグメントの方が直径が大きい。この2セグメント形集束グリッド電極はホトカソードと半導体チップとの間の中間の領域に配置されており、200ボルトより低い比較的低い集束電圧が印加されている。

【0007】半導体チップ保持部材は管の軸上に配置されている。この半導体チップ保持部材は、それが整合伝送線路終端部材として動作する回路中に接続出来るように構成されている。更に、半導体チップは、電子ビームの集束クロスオーバー領域に位置するように、管の軸に沿って間隔をおいて設けられている。このように構成することにより、大面積のホトカソードから放出された全ての電子が比較的小面積のホトダイオードに作用することができるよう、電子が細いビームに形成されて、高収集効率が得られる。

【0008】この簡単な構造を、周知の光電子増倍管製造技術を用いて、適切な幾何学的寸法形状で作り、真空外囲器内に配置することにより、従来の半導体光電子増倍管より優れた動作特性を持った半導体光電子増倍管を得ることができる。

【0009】

【実施例の詳細な説明】図は、この発明の推奨実施例による光電子増倍管の半分をその軸に沿う断面で示す。他の半分はその外面が示されている。光電子増倍管10は、実質的に同軸構造として形成されており、ホトカソード12がガラス製の窓13の内側に、半導体ホトダイオード14が管10のホトカソード12と反対の側の端部に配置されたチップ保持部材15上に、陽極集束電極16が半導体ホトダイオード14の近傍に、グリッド集束電極18が管軸に沿った略中間の位置にそれぞれ配置されており、更に、適当なセラミック絶縁壁部20、22、24及びフランジ35、36、37とにより管10の真空外囲器が形成されている。

【0010】推奨実施例においては、半導体ホトダイオード14は「電子衝撃誘導コンダクティビティ」モードで動作するシリコンダイオードであるが、同じモードで動作するシリコン・アバランシェダイオードを用いることもできるし、他の形式の半導体ホトダイオードも図示の推奨実施例の構成中で用いることができる。実際、光のレベルが低い場合には、シリコン・アバランシェダイオードの方がより良好な動作をする。

【0011】窓13に関して、図示の実施例に変更を加えることができる。窓13は図に実線で示すように、2つの平行な平坦面で構成することもできるし、また、点線26で示すように、内表面を光電子増倍管10内に曲率中心を持つ凹面としたものを用いてもよい。窓13の内表面を湾曲した凹面26とした場合には、その外表面

は平坦面としても、凹面としてもよい。内表面を凹面とした場合、外表面がどちらの形状であれ、同じ小さな直径のホトダイオードであれば、2面が共に平坦であるものよりも良好なタイミング特性が得られ、更に、陰極収集効率も良好になる。

【0012】この発明の推奨実施例においては、同軸光電子増倍管10のホトカソード12からホトダイオード14までの軸方向の長さは、約58.42mm(約2.3インチ)、絶縁部材22と24で形成される外囲器の内径は約63.5mm(約2.5インチ)である。ホトダイオード14の実効的な直径は約2.5mmに過ぎず、一方、ホトカソード12の直径は約50mmである。従って、ホトカソード12とホトダイオード14の面積の比は、約400対1である。この非常に大きな面積比は、ホトダイオード14を管軸上で、かつ、同軸的に配置された集束電極16、18によって形成される集束電界のクロスオーバー点に配置させることにより達成できる。

【0013】推奨実施例における陽極集束電極の位置は、ホトダイオード14と管10の中心軸との関係において定めるのが最も良い。即ち、陽極集束電極16の同軸シリンダ状表面はホトダイオード14の中心から約8.38mm(約0.33インチ)の半径上にあり、このホトダイオード14の中心は管10の軸上にあるからである。更に、陽極集束電極16はホトダイオード14からホトカソードに向かって管10に沿って軸方向に約10.16mm(約0.4インチ)延びている。

【0014】推奨実施例の光電子増倍管10における同軸グリッド集束電極18の位置はホトカソード12との関係でより簡単に定めることができる。前述した管10の寸法では、グリッド集束電極18のホトカソード12側の端部はホトカソードから約20.32mm(約0.8インチ)の位置にある。グリッド集束電極18はセグメント(部分)28と30とで構成されている。大きいほうのセグメント28は、内径が約50.8mm(約2インチ)で、管軸に沿う長さが約18.58mm(約0.73インチ)であり、小さいほうのセグメント30は、内径が約49.276mm(約1.94インチ)で、管軸に沿う実効長が約7.62mm(約0.3インチ)である。光電子増倍管10に、これらの寸法を採用し、約100ボルトを上述のグリッド構造に加えると、実質的に100%の収集効率を得ることができる。

【0015】この発明の特筆すべき利点は、半導体ホトダイオード14に対する接続を外部回路に整合するような構成にすることができる点である。チップ保持部材15は管10の端部シールとして機能する。チップ保持部材15上に取り付けられたホトダイオード14に対する接続体32はワイヤでもストリップ接続体でもよい。この基本構造の寸法形状は、それが後続の回路に対し整合した終端となるインピーダンスを呈するように、従っ

